SYNOPSIS

FOR THE AWARD OF THE DEGREE OF DOCTOR OF PHILOSOPHY IN GEOGRAPHY

Ph.D. Thesis entitle

Spatio-temporal Analysis of Agricultural Development of Koppal District: A Geographical Approach

POST GRADUATE DEPARTMENT OF STUDIES AND RESEARCH IN GEOGRAPHY
MANGALORE UNIVERSITY
MANGALAGANGOTHRI-574199
KARNATAKA

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Ph.D. Final Thesis SYNOPSIS

Submitted by

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SYNOPSIS OF THE Ph.D. THESIS

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TABLE OF CONTENT

CONTENT	PAGE No.
Introduction	1-2
Study area	2-3
Objectives of the study	3-4
Chapter 1: Introduction	4
Methodology	4
Chapter 2: Physical setting	4
Chapter 3: Human Resources	5
Chapter 4: Land use Pattern	5-7
Chapter 5: Irrigation	8-9
Chapter 6: Cropping Pattern	9-20
Chapter 7: Agriculture Development	21-25
Chapter 8: Findings, Strategies and Conclusion	25-33
Bibliography	34-54
Workshops / conferences / webinar presented and attended	55
Publications	55

LIST OF FIGURES

FIGURE NO.	CONTENT	PAGE NO.
1	Study area	3
2	Land use Land cover of Koppal District in 2010-11	6
3	Land use Land cover of Koppal District in 2020-21	6
4	Volume of Change in LULC in 2010-11	7
5	Volume of Change in LULC in 2020-21	7
6	Intensity of Irrigation 2010-11 and 2020-21	9
7	Koppal District Crop Combination Regions By J.C. Weaver's Method (2010-11 and 2020-21)	14
8	Intensity of Cropping Regions 2010-11 and 2020-21	18
9	Koppal District Crop Diversification 2010-11 and 2020-21	20
10	Koppal District Composite Crop Yield Indices 2010-11 and 2020-21	23
11	Koppal district Airable Land use Efficiency by V. Vidyanath's Method	24

LIST OF TABLES

TABLE NO.	CONTENT	PAGE NO.
1	Comparing statistics of LULC of the year 2010-11 and 2020-21	5
2	Koppal District Intensity of Irrigation Categories	8
3	Area under Different Crops in Hectares and percentages 2010-2011	10
4	Area under Different Crops in Hectares and percentages 2020-2021	11-12
5	Crop Combination BY J.C. Weaver's Method	13
6	Koppal District Intensity of Cropping Regions	17
7	Koppal District Crop Diversification Categories for 2010-2011 and 2020-2021	19
8	Koppal District Composite Crop Yield Indices	22
9	Koppal District Arable Land Use Efficiency Regions- A New Method by V. Vidyanath	22

Spatio-Temporal Analysis of Agricultural Development of Koppal District: A Geographical Approach

INTRODUCTION

Agriculture is considered as a very important process in the world. Every Living being and his life is, directly and indirectly, connected with agriculture. Agriculture plays an important role in economic, social, and cultural development, such as the provision of food to the nation, enlarging exports, transfer of manpower to non-agricultural sectors, contributing to capital formation, and securing markets for industrialization.

The term agriculture can be interpreted in many ways. Over the decades after the linkage between agriculture and human origin, more and more farmers are dependent on agriculture for livelihood and commercial purposes. In the first phase, he found food for himself before living in a single place through hunting, fishing, and gathering. In the Neolithic Period, they began to find food to get out of the caves. The Middle East countries were the first to cultivate and grow animals if they checked the history of agriculture. In 7000 BC America, Thailand, Mexico, north and Southern parts of Asia started to cultivate different types of crops. Since then, it has been found that not only food products but also a wide variety of by- products. Traditional industries that are found today are largely dependent on agriculture. That is, the production of a country and a variety of products are factors that influence the growth of that country. Thus, the word "agriculture" has a great influence on the country's overall growth.

A process known as agriculture depends on several factors, On the other hand, agriculture is possible only through the influence of many factors. such as, geographical, political, and economical factors. A farmer is mainly dependent on such things. Therefore, often the loss or progress of agriculture is due to the availability of these components or the shortage of these components.

Agriculture development has defined in many ways, but in reality, it is measured through the geographical, Social, and economic, status of the farmers. Agriculture development plays a very important role in the overall development of the nation.In recent years agriculture field has made great improvement through using modern technology, high variety of seeds, development in irrigation facility, fertilizers, pesticides, etc. In general, agricultural development is the process of creating conditions to ensure that agricultural

potential is realized. It aims to increase the growth rate of the agricultural sector by improving crop production and productivity. This can help to strengthen farmers economically and improve their status and lifestyle.

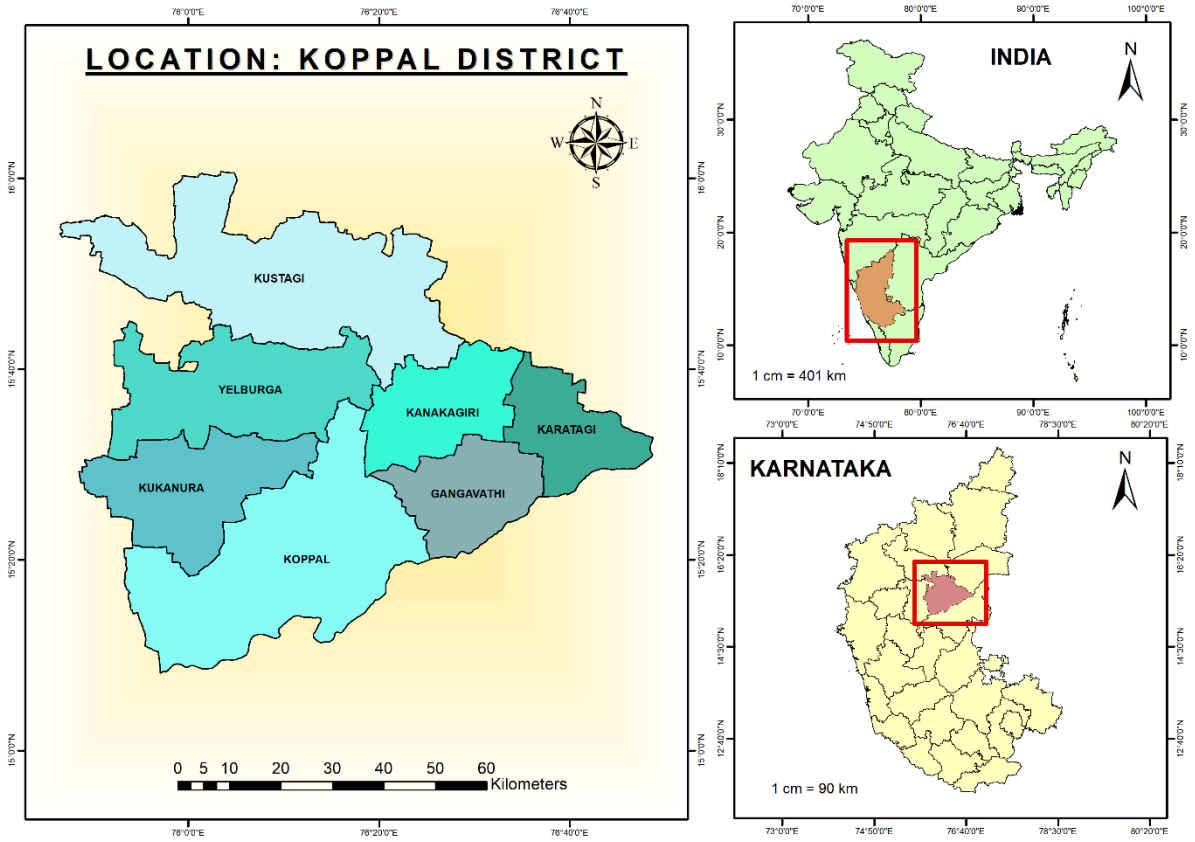
The present study examines spatio-temporal changes and agriculture development in Koppal district. The results of the study will give a reasonable understanding of the agricultural development of the Koppal district. The study will help to address issues in the agriculture sector, factors affecting agricultural development, agriculture scenario of the Koppal district.

STUDY AREA

Koppal district is situated in northern part of Karnataka state. The district encompasses an area of 5,52,495 hectares lying between the latitudinal parallels 15°09′ to 16°03′ north latitude and 75°47′ to 76°48′ east longitude. In its shape the district may be regarded as roughly resembling inverted triangle shape, as per Peter Hegget's shape index method. It consists of four talukas namely, Gangavati, Koppal, Kushtagi and Yelburga. Later in the year 2017 Three more talukas are formed they are Kanakagiri, Karatagi and Kukanuru now district consists of seven taluks. The district is bound in the north by Raichur and Bagalkot districts, in the west by Gadag district, in the south by Bellary district and in the east by again Bellary and Raichur districts.

The area falls in the Tungabhadra sub-basin of the Krishna basin. Tungabhadra River flowing in southern boundary in north-easterly direction and it is main Perennial River. Tungabhadra River flows in between Davangere, Haveri, Gadag, Bellary and Koppal district. The main streams draining the area of the district are Maskinala, Ilkal-nadi and Hirenala. These are ephemeral in nature; these are also coming under Tungabhadra sub-basin. The drainage exhibits dendritic to sub-dendritic patterns.

Figure No:1 Location map of the study area



Objectives of the Study

The objectives of the study are:

1. To know the importance of non-physical determinants for the development of Agriculture.
2. To Access the pattern of Land use Land cover in the study area.
3. To know the patterns of Irrigation in the study area.
4. To examine and understand the nature and extent of major agricultural crops in different seasons and their patterns in Koppal district of Karnataka, India;
5. To examine and assess the trends (positive, increasing and negative, decline) in various but particularly in some very dominant crops as well as in landforms in the study area.
6. To appreciate the existing and the likely future problems of agriculture and cropping in the study area.

7. To assess the social-economic changes and impacts of agriculture of the study area. Towards recommending measures that would make such impacts positive for the development of the study area.
8. To Suggest Remedies and Strategies for the development of agriculture in the study area.

Chapter I : Introduction

The chapter begins with a general introduction to agriculture. It also gives an overview of World agriculture, Indian agriculture, and Karnataka agriculture and Koppal agriculture. This chapter also includes a selection of s study areas, objectives, methodology, the relevance of the study, organization of thesis, and literature review carried out to define the specific research problem decisively.

Methodology

To study the various aspects of agricultural geography of Koppal District of Karnataka state, the data for two periods i.e., 2010-2011 and 2020-2021 are taken from the different sources.

The present work is based on primary and secondary data. Primary data is based on actual field work by questionnaire and a personal interview method.

Data has been collected from various government and Semi-government offices and respondents from different villages. Taluka wise One village has been randomly selected for survey work.

The study has been analysed with the help of latest Quantitative Techniques, like Intensity of Irrigation, Intensity of Cropping, Ranking of crops, Crop Combination, Crop Concentration, Crop diversification, Crop Productivity, Arable Land use Efficiency, Rank order score method, Maps, Diagrams and Photos.

CHAPTER II: PHYSICAL SETTINGS

Chapter II deals with all physical characteristics of the study area. And it included the location of the study area on a map. And it describes physical settings like geomorphology, geology, soil, forest and climate in detail with maps.

Chapter-III: HUMAN RESOURCES

This chapter deal with the human resources of the study area. It includes the total population, Density of population. Literacy. Working population, Variation in rural and urban population. Land and population ratio, Sex ratio, Occupational structure, Land holdings details.

Agriculture development is possible only because of well-balanced combinations of physical and non-physical elements, mainly demographic factors. which are held together to create steady agriculture. Physical features include geomorphology, geology, climate, soil, and availability of water resources. Non-physical factors, include population, working population, occupational structure, literacy, animal distribution transportation etc.

According to 2021 projected population the total population of the Koppal district is 1615277. According to projected population data high, low rural population and high, low urban population is found in Kustagi and Karatagi talukas. The density of the population of the Koppal district is 254. The highest and lowest density is found in Gangavathi and Kukanuru talukas. The sex ratio of the district is 987.57. The Literacy of the district is 680.9%. Total working population of the district is 755926.

Chapter-IV: LAND USE PATTERN

This chapter deals with the spatiotemporal changes in land use land cover of the study area. In this study, the LULC data set was created using time-series Landsat imageries for about 10 years from 2011 to 2021 for the Koppal district of Karnataka state, India. The study adopted a combination of remote sensing and GIS methods to quantitatively characterize the LULC change of the study area. There is some fluctuation in the land use and land cover from 2011 to 2021.

Table No: 1 Comparing statistics of LULC of the year 2010-11and 2020-21
(Area in hector)

Land use	2011	2021	Changes %
Forest	29451(5.33)	29451(5.33)	(0)
Land not available for agriculture	55630(10.06)	73449(13.29)	17819(+3.2)
Other uncultivated land excluding fallow land	17453(3.15)	20620(3.73)	3167(+0.58)
Fallow land	80104(14.49)	16634(3.01)	63470(-11.48)
Net sown are	369857(66.94)	412361(74.63)	+42504(+7.7)

(***Source: Compiled by research scholar)***

Figure no 1.2 Land use land cover of Koppal district in 2011

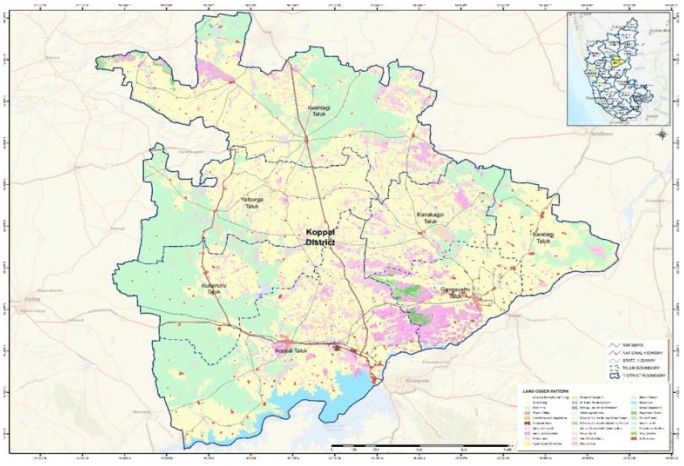


Figure no 1.3 Land use land cover of Koppal district in 2021

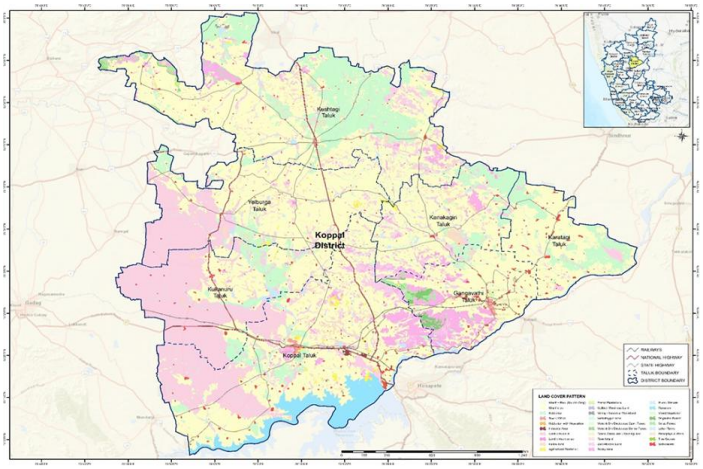


Figure no.4 changes in land use land cover in 2010-11

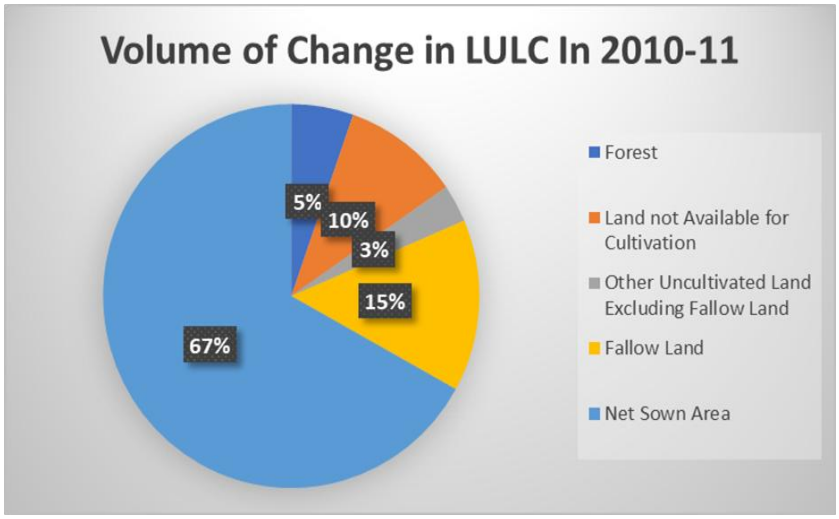
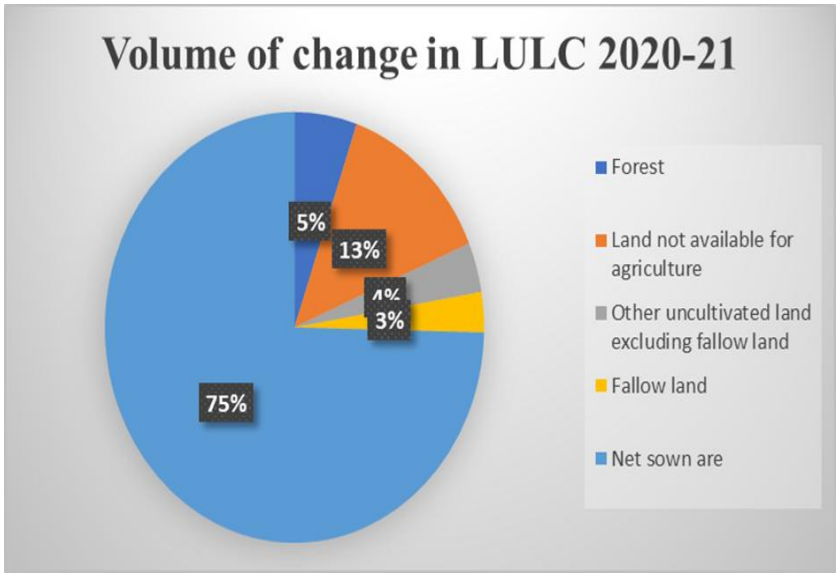


Figure no 5 changes in land use land cover in 2020-21



Analyzing the land use and Land cover of Koppal district, fallow land is converted into Net sown area, and for built up activity, there is well connected transport network so we can see the transition of slow urban growth. The farmers of Koppal district concentrating more on food crops rather than cash crops. But the productivity is low so this study signifies prepare better policies to improve the productivity of the crops.

Chapter-V: IRRIGATION

This chapter deals with the types of irrigation, intensity of irrigation, Potentiality of

Surface and Underground Water, and Remedial measures. Irrigation plays a very important role in agriculture. In Koppal district Canal and Borewell irrigation are well developed.

In the year 2010-11 Gangavathi has highest percentage of Canal irrigation in the district, and there is no canal irrigation in Kustagi and Yelburga talukas. Where as in the year 2020-21 Karatagi has highest percentage of canal irrigation. There is no canol irrigation in Kustagi, Kukanuru, and Yelburga talukas. There is no Tank and Well irrigation in the entire Koppal district in both the study periods i.e., in 2010-11 and 2020-21. In both the study periods i.e., 2010-11 and 2020-21 Koppal taluk has highest percentage of Bore well irrigation. In both the study periods i.e., the other sourcess of irrigation is found in Gangavathi, and Koppal talukas only.

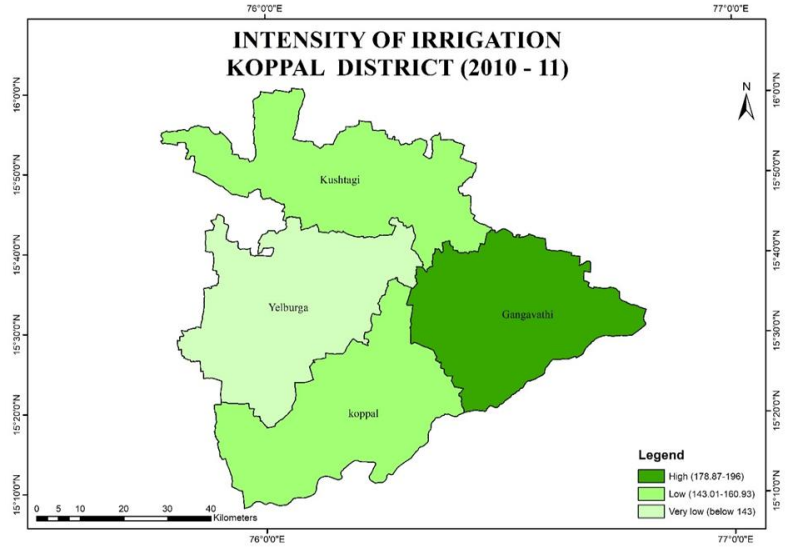
Table-2

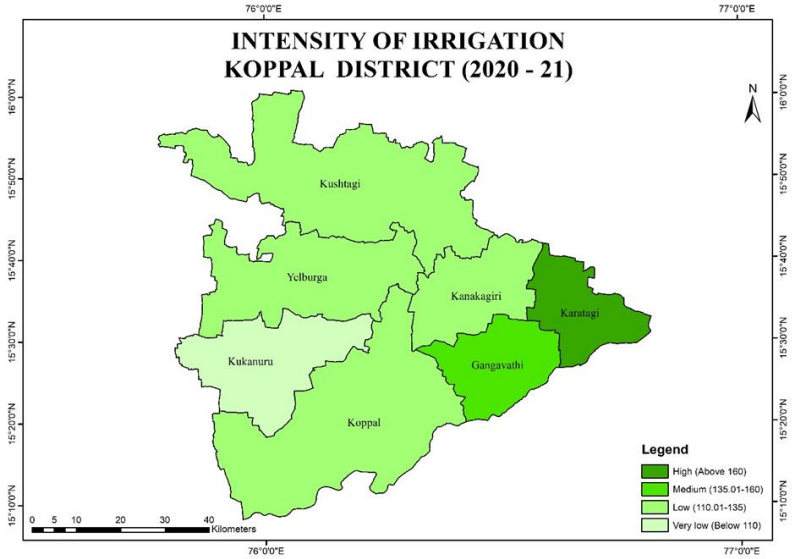
Koppal District Intensity of Irrigation Categories

Sl. No.	2010-2011				2020-2021			
	Intensity Categories	Rate of Intensity	No. of Talukas	Name of the Talukas	Intensity Categories	Rate of Intensity	No. of Talukas	Name of the Talukas
1	Very Low	Below 143	1	Yelburga	Very Low	Below 110	1	Kukanuru
2	Low	143.01-160.93	2	Koppal, Kustagi	Low	110.01-135.00	4	Koppal, Kushtag Kanakagir Yelburgai
3	Medium	160.94-178.86	0	Nil	Medium	135.01-160.00	1	Gangavathi
4	High	178.86-196	1	Gangavathi	High	160.01-185.00	1	Karatagi
5	Very high	Above 196	0	Nil	Very High	Above 185	0	Nil

Source: Compiled by the researcher

Fig no 6 Intensity of irrigation in 2010-11





Chapter-VI: CROPPING PATTERN

Crop combination, crop concentration, crop diversity and ranking of crops are important techniques in agricultural geography. In this study period mainly fifteen crops area grown in the Koppal district. Cropping patterns help us to know about the major crops of the study area and how the area under each crop is changing yearly. So, this study discusses about food crops, Pulses, Oil seeds, and Cash crops have seen in this area. The food crops area is increasing, and area under Oil seeds and Cash crops are decreasing.

The crops in the Koppal district are classified into food crops, pulses, Oil seeds, and Cash crops Different variety of crops is cultivated all over the district. Table 2 and 3 shows the major crops of the Koppal district. The farmers mainly focusing food crops and pulses.

Table no. 3 Area under Different Crops in Hectares and percentages - 2010-2011

Sl. No.	Name of the Talukas	Paddy	Ragi	Jowar	Bajra	Wheat	Maize	Minor Millets	Bengal Gram	Tur	Horse Gram	Green Gram	Ground nut	Sun Flower	Sugar cane	Cotton	Total Sown Area to District Total
1	Gangavati	69955	0	10021	6194	154	3607	594	4292	2781	745	1047	7773	8470	291	1583	117507
	%	59.14	0	8.52	5.26	0.13	3.06	0.50	3.61	2.36	0.63	0.89	6.61	7.20	0.24	1.34	25.99
2	Koppal	7869	0	10283	17153	2010	27555	563	10482	2365	2117	2452	11511	5857	1945	4539	106707
	%	7.37	00	9.67	16.07	1.88	25.82	0.52	9.82	2.21	1.98	2.21	10.78	5.48	1.82	4.25	23.60
3	Kushtagi	203	0	18328	29108	1771	5884	760	8581	4622	4134	3967	10832	13104	NA	4248	111382
	%	0.19	0	17.39	27.62	1.68	5.58	0.72	8.14	4.42	3.92	3.76	10.28	12.43	NA	4..3	22.43
4	Yelburga	107	0	22446	14442	5221	11141	968	17719	2909	3751	4583	16885	15204	14	10997	126387
	%	0.08	0	17.76	11.42	4.13	8.81	0.76	14.02	2.30	2.96	13.36	13.36	12.03	0.01	8.87	27.96
	Dist. Total	78134	0	61078	66897	9156	48187	2885	41074	12677	10747	12049	47001	39951	2250	21367	451977
	%	17.32	0	13.51	14.80	2.02	10.66	0.63	9.08	2.80	9.08	2.66	10.39	9.43	0.49	4.72	100

(Source: Koppal Distract at a glance 2010-11)

Table no. 4 Area under Different Crops in Hectares and percentages - 2020-2021

Sl. No.	Name ofthe Talukas	Paddy	Ragi	Jowar	Bajra	Wheat	Maize	Minor Millets	Bengal Gram	Tur	Horse Gram	Green Gram	Ground nut	Sun Flower	Sugar cane	Cotton	Total Sown Area to District Total
1	Gangavati	35637	4	131	2808	0	542	806	107	55	24	3	226	97	2	25	40467
	%	88.06	0.009	0.32	6.93	0	1.33	1.99	0.76	0.13	0.05	0.007	0.55	0.23	0.004	0.06	7.69
2	Kanakagiri	3385	11	2429	16220	7	1856	1868	2045	4539	336	189	1844	597	5	1548	36331
	%	9.31	0.03	6.68	44.64	0.01	5.1	5.14	5.62	12.43	0.92	0.52	5.07	1.63	0.01	4.26	6.90
3	Karatigi	52692	1	846	21	0	68	11	1773	25	6	11	1	84	63	25	55617
	%	94.74	0.001	1.52	0.03	0	0.12	0.01	3.18	0.04	0.01	0.01	0.001	0.15	0.11	0.04	10.57
4	Koppal	8280	13	8780	23152	264	21376	433	12630	2356	615	1883	3602	7237	1652	2079	94352
	%	9.09	0.01	9.30	24.52	0.27	22.65	0.45	13.38	2.49	0.65	2.0	3.81	7.67	1.75	2.2	17.93
5	Kukanuru	88	1	8758	5881	639	6927	156	23031	2297	293	7340	4952	3574	40	612	64599
	%	0.13	0.001	13.55	9.1	0.13	10.72	0.24	35.65	3.55	0.45	8.87	7.1	3.77	0.06	0.94	12.27

Continued…….

Sl. No.	Name ofthe Talukas	Paddy	Ragi	Jowar	Bajra	Wheat	Maize	Minor Millets	Bengal Gram	Tur	Horse Gram	Green Gram	Ground nut	Sun Flower	Sugar cane	Cotton	Total Sown Area to District Total
6	Kustagi	186	52	14784	37401	170	10878	1144	13067	19017	3101	11095	6594	4715	106	2637	124947
	%	0.14	0.04	11.83	29.93	0.13	8.70	0.91	10.45	15.22	2.48	8.87	5.27	3.77	0.08	2.11	23.76
7	Yelburga	108	20	5738	21201	569	12754	344	18478	5350	1410	5994	8691	2151	91	1727	109864
	%	0.09	0.01	5.22	19.30	0.51	11.60	0.31	16.81	4.86	1.28	5.54	7.91	1.95	0.08	1.57	20.87
	District Total	100376	112	41466	106690	41466	54401	4762	71131	33633	5785	26515	25910	18455	1959	8653	526177
	%	19.07	0.02	7.88	20.27	0.31	10.33	0.90	13.51	6.39	1.02	5.03	4.92	3.50	0.37	1.64	100

(Source: Koppal Distract at a glance 2020-21)

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Table No.5 Crop Combination BY J.C. Weaver's Method

Sl. No	Taluks	2010-11	2020-21	Change of no. of crops
1	Gangavathi	14 crops- P, J, B, W, M,MM, T, HG, BG, GG,GN, SF, C, SC	1 crop- P	-13
2	Koppal	9 crops- M, B, GN, BG,J, P, SF, C, GG	6 crops- B, M, BG, J, P, SF	-3
3	Kustagi	10 crops- B, J, SF, GN BG, M, T, C, HG, GG	7 crops- B, T, M, J, BG, GG, GN	-3
4	Yelburga	7 crops- J, BG, GN, B, SF, M, C	7 crops- B, BG, M, J, T, GN, GG	Nil
5	Kanakagiri	14 crops- P, J, B, W, M, MM, T, HG, BG, GG, GN, SF, C, SC	15 crops- P, J, B, W, M, MM, T, HG, BG, R, GG, GN, SF, C, SC	Nil
6	Karatagi	NA14 crops- P, JW, M, MM, T, HG, BG, GG, GN, SF, C, SC	1 crop- P	Nil
7	Kukanuru	7 crops- J, BG, GN, B, SF, M, C	8 crops- B, BG, M, GG, GN, SF, T	Nil

Index:

P= Paddy M= Maize BG= Bengal gram C= Cotton

J= Jowar MM= Minor millet GG= Green gram SC= Sugar cane

B= Bajra T= Tur GN= Ground nut R= Ragi

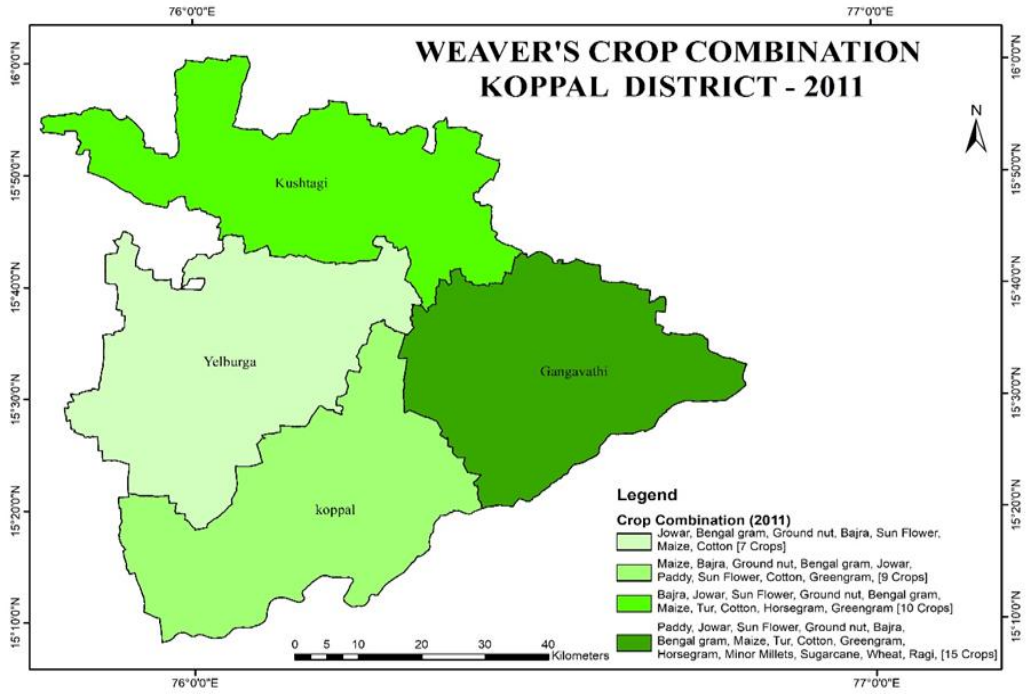
W= Wheat HG= Horse gram SF= Sun flower

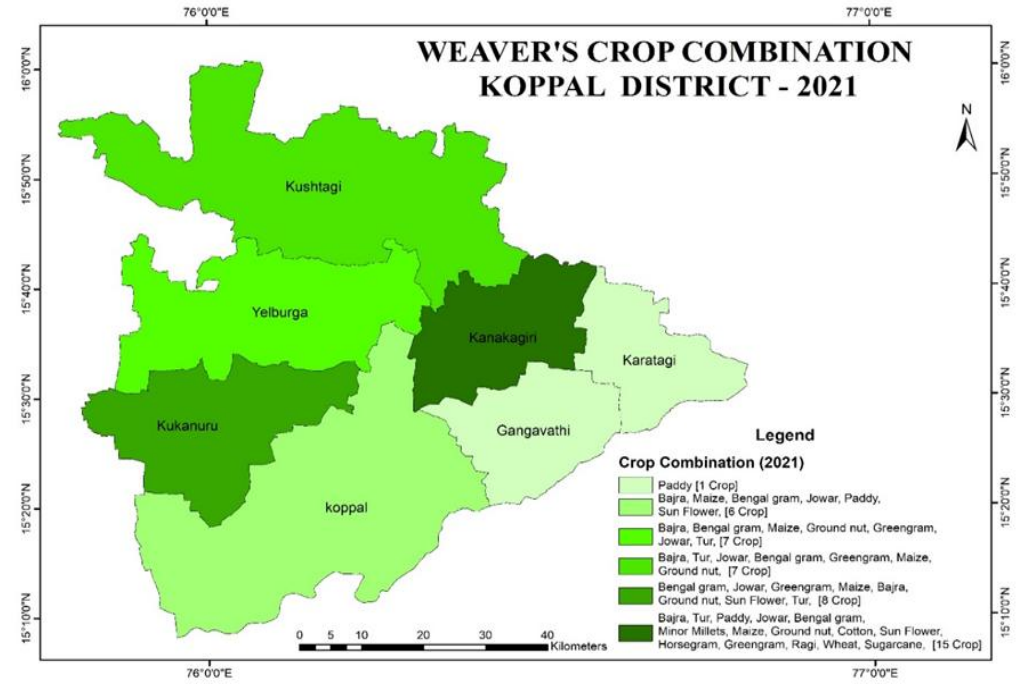
Note: Kanakagiri, Karatagi, and Kukanuru talukas are formed in 2017

Fig 7

Koppal District Crop Combination Regions

By J.C. Weaver's Method (2010-11 and 2020-21)


WEAVER'S CROP COMBINATION
KOPPAL DISTRICT - 2011
N
Kushtagi
Yelburga
Gangavathi
koppal
Legend
Crop Combination (2011)
Jowar, Bengal gram, Ground nut, Bajra, Sun Flower, Maize, Cotton [7 Crops]
Maize, Bajra, Ground nut, Bengal gram, Jowar, Paddy, Sun Flower, Cotton, Greengram, [9 Crops]
Bajra, Jowar, Sun Flower, Ground nut, Bengal gram, Maize, Tur, Cotton, Horsegram, Greengram [10 Crops]
Paddy, Jowar, Sun Flower, Ground nut, Bajra, Bengal gram, Maize, Tur, Cotton, Greengram, Horsegram, Minor Millets, Sugarcane, Wheat, Ragi, [15 Crops]
0 5 10 20 30 40 Kilometers
76°0'0"E
77°0'0"E
16°0'0"N
15°50'0"N
15°40'0"N
15°30'0"N
15°20'0"N
15°10'0"N



The above table (No.4) shows the crop combination analysis, as per the weaver's method, the district exhibits monoculture to fifteen crop combinations. It can be noted that the combination of crops is mainly Monoculture, and seven crop combination.

The crop concentration study helps us to know which are the talukas that can be affected by degradation of the soil ecology and how changing the range of concentration can reduce it. There is a need to identify crops and varieties that may suit a range of environments and farmers' preferences.

The study examines the crop concentration of the Koppal district based on statistical data. During 2010-2011 high concentration of paddy is found in Gangavathi taluk and low concentration is found in Yelburga taluk. In 2020-21 High concentration is found in Karatagi taluka and low concentration in Kustagi taluka. During 2010-11 high concentration of Jowar is found in Yelburga taluka, and low concentration is found in Gangavathi taluka. In 2020-21 high concentration is found in Kukanuru and low concentration is again found in Gangavathi taluka. In 2010-11 high concentration of Bajra is found in Kustagi taluka, and low concentration is found in Gangavathi taluka. In 2020-21 high concentration is found in Kanakagiri taluka, and low concentration is found in Gangavathi taluka. During 2010-11 high concentration of Maize is found in Koppal taluk, and low concentration is found in Gangavathi taluka, in 2020-21 high concentration is found once again Koppal taluka, and low concentration is found in Karatagi taluka. During 2010-11 high concentration of Wheat is found in Yelburga taluka, and low concentration is found in Gangavathi taluka. In 2020-21 high concentration is found in Kukanuru taluka, and low concentration is found in Kanakagiri taluka. During 2010-11 there is no Ragi crop in the entire Koppal district. In 2020-21 high concentration of Ragi is found in Kustagi taluka and low concentration is found in Gangavathi taluka. During 2010-11 high concentration of Minor millet is found in Yelburga taluka and low concentration is found in Gangavathi taluka. In 2020-21 high concentration is found in Kanakagiri taluka and low concentration is found in Karatagi taluka. During 2010-11 high concentration of Tur is found in Kustagi taluka and low concentratiob is found in Gangavathi taluka. In 2020-21 high concentration is found in Kanakagiri taluka and low concentration is found in Kukanuru taluka. During 2010-11 High concentration of Horse gram is found in Kustagi taluka and low concentration is found in Gangavathi taluka. In 2020-21 high concentration is found in Gangavathi and low concentration is found in Kukanuru taluka. During 2010-11 high concentration of green gram is found in Kustagi taluka and low concentration is found in Gangavathi taluka. In 2020-21 high concentration is

found in Kustagi and low concentration is found in Gangavathi taluka. During 2010-11 high concentration of Bengal gram is found in Yelburga taluka and low concentration is found in Kustagi taluka. In 2020-21 high concentration is found in Gangavathi taluka and low concentration is found in Kustagi, and Kukanuru taluka. During 2010-11 high concentration of Ground nut is found in Koppal taluka and low concentration is found in Kustagi taluka. In 2020-21 high concentration is found in Yelburga taluka and low concentration is found in Karatagi, and Koppal talikas. During 2010-11 high concentration of Sun flower is found in Gangavathi taluka and low concentration is found in Koppal taluka. In 2020-21 high concentration is found in Karatagi taluka and low concentration is found in Kanakagiri and Yelburga talukas. During 2010-11 high concentration of Cotton is found in Yelburga taluka and low concentration is found in Gangavathi taluka. In 2020-21 high concentration is found in Kanakagiri taluka and low concentration is found in Karatagi taluka. During 2010-11 high concentration of Sugar cane is found in Koppal taluka and low concentration is found in Kustagi taluka. In 2020-21 High concentration once again found in Koppal district and low concentration is found in Gangavathi taluka.

Crop diversification provides better conditions for food security and enables farmers to grow surplus products for sale at the market and thus helping to obtain increased income to meet other needs related to household well-being. In the study period diversification of crops differs from one year to another year. Each period displays low, medium, and high diversification. As per statistics, there is no uniformity in crop diversification. There were radical variations that occurred Kasaragod district. During 2010-2011, high diversification has seen in Gangavathi, medium diversification was found in Koppal. And low diversification was found in Kustagi and Yelburga. In 2020-21, a high diversification was found in Gangavathi and Karatagi. medium diversification was noticed in this period. The remaining Kanakagiri, Koppal, Kukanuru, Kustagi, and Yelburga noticed moderate diversification.

Table 6 Koppal District Intensity of Cropping Regions

Sl. No	2010-11				2020-21			
	Intensity Categories	Rate of Intensity	No of Talukas	Name of the Talukas	Intensity Categories	Rate of Intensity	No of Talukas	Name of the Talukas
1	Very low	Below 124.48	Nil	Nil	Very Low	Below108.99	Nil	Nil
2	Low	123.49 -136.13	3	Koppal, Kustagi ,Yelburga	Low	109-124.99	2	Koppal Yelburga
3	Medium	136.14 -157.78	Nil	Nil	Medium	125-139.99	1	Kukanuru
4	High	157.58 -170.43	1	Gangavathi	High	140-170	4	Karatagi, Kanakagiri Gangavathi Kustagi
5	Very high	Above 170.43	Nil	Nil	Very high	Above 170	Nil	Nil

Source: Compiled by the Researcher

Fig 8 Intensity of Cropping Regions 2010-11 and 2020-21

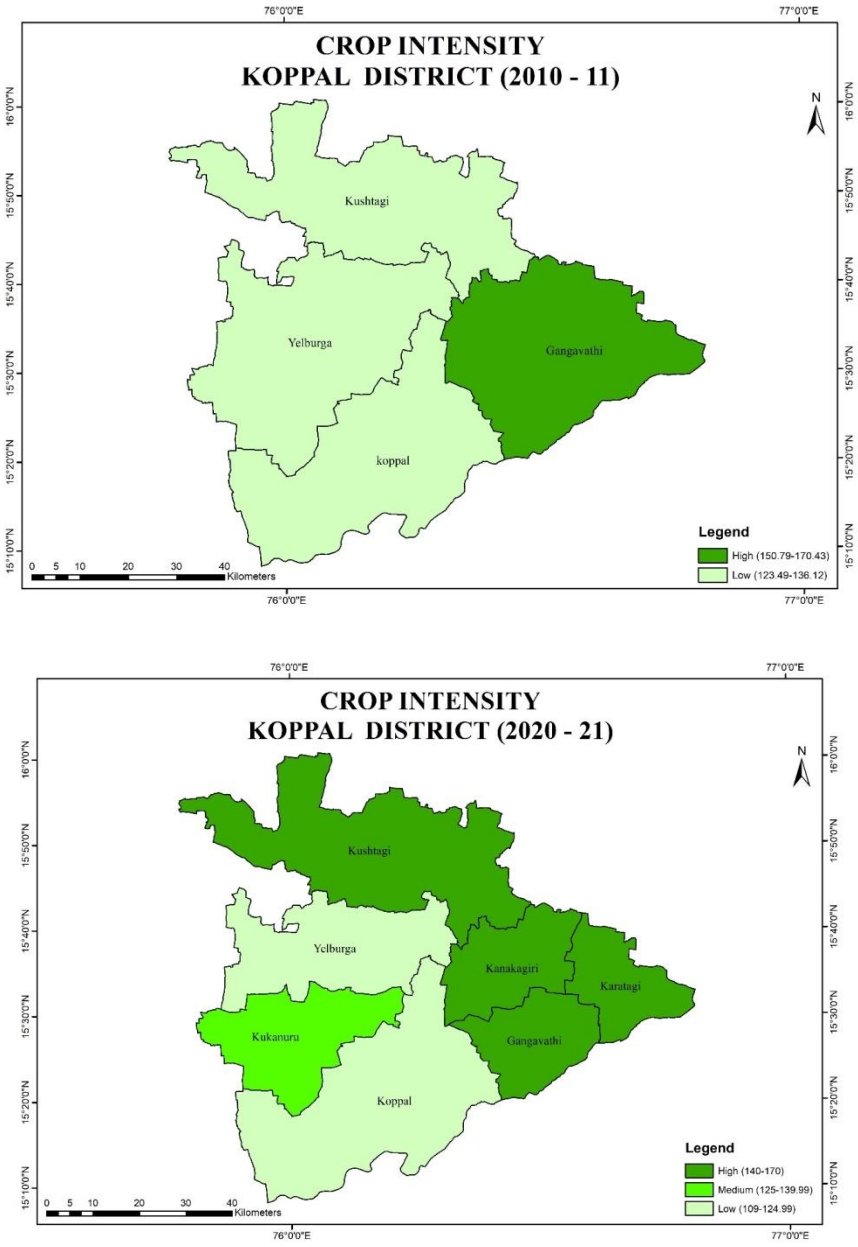
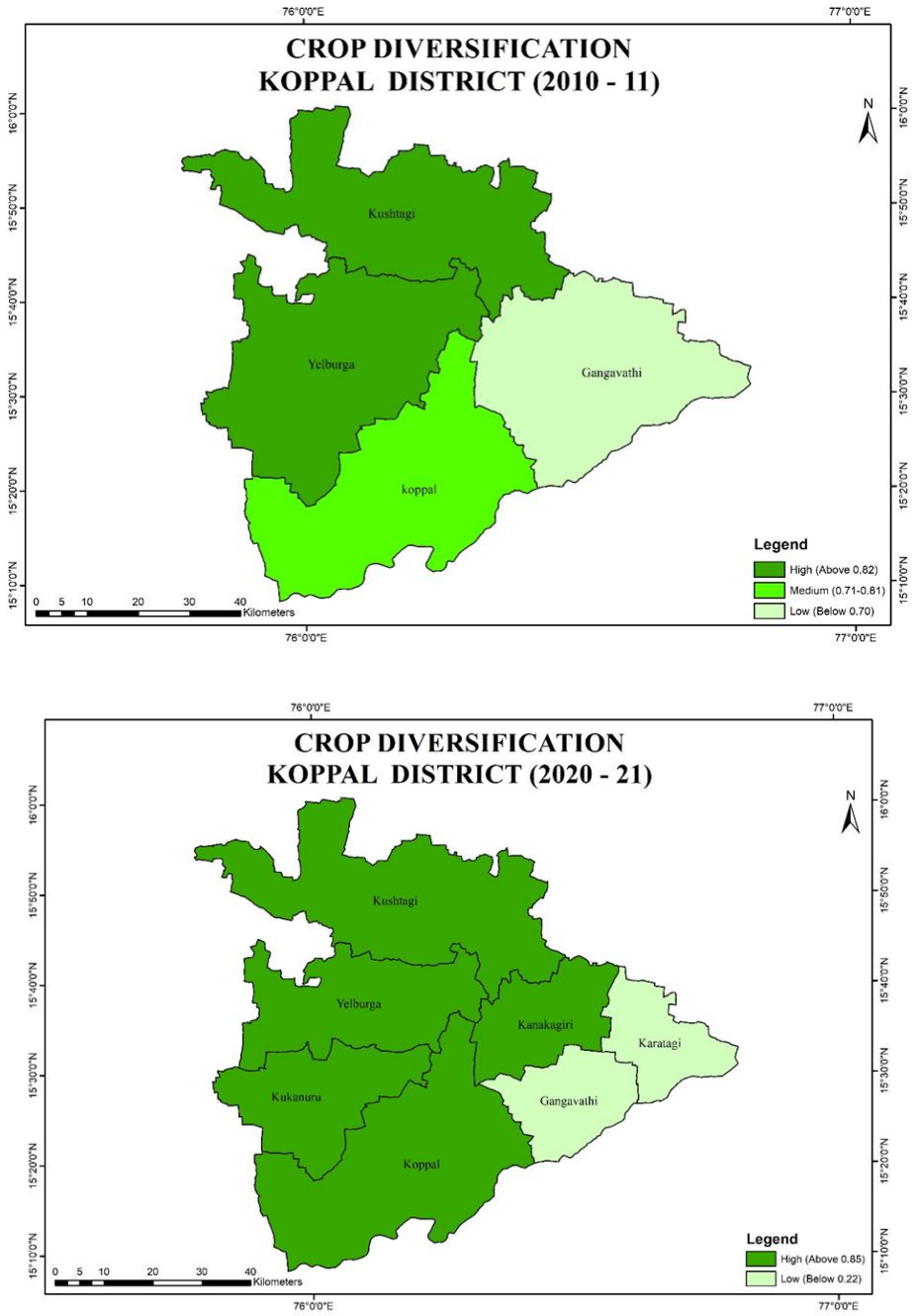


Table- 7 Koppal District Crop Diversification Categories for 2010-2011 and 2020-2021

Diversification categories	2010-11			2020-21		
	Range of crop diversification	No of Talukas	Name of the Talukas	Range of crop diversification	No of Talukas	Name of the Talukas
Low	Below 0.70	1	Gangavathi	Below 0.50	2	Gangavathi, Karatagi
Medium	0.71 to 0.81	1	Koppal	0.50 to 0.80	Nil	Nil
High	Above 0.82	2	Kustagi, Yelburga	Above 0.80	5	Kanakagiri, Koppal,Kukanuru, Kustagi,Yelburga

Source: Compiled by the researcher

Fig.9 Koppal District Crop Diversification 2010-11 and 2020-21



CHAPTER VII: AGRICULTURAL DEVELOPMENT

Agricultural Development is an indispensable factor for the sound economic growth of a country and it involves the optimum and maximum economic utilisation of land. Because of the uneven distribution of physical, economic, and social, factors agricultural development can be uniform in all the parts of the district. For a balanced development of a region, it is the prime need to pay more attention to the low developed regions. For this

purpose, following approaches have been taken into account such as agricultural project productivity, agricultural efficiency, levels of Agriculture Development, and infrastructural facilities. Finally, a combined overall picture of Abu aspects of Agriculture Development is also necessary as they will help in the delineation of developed, developing, and backward agricultural areas. Hence, in this analysis an attempt has been made to measure the taluk wise disparity in the levels of Agriculture Development based on the availability of data.

Agriculture productivity in the study period differs from one year to another year. During 2010-11 Kustagi has low productivity, Koppal and Yelburga has medium productivity, and Gangavathi has high productivity. During 2020-11 Kustagi, Koppal, and Yelburga has low productivity, Gangavathi, and Kukanuru has medium productivity, and Kanakagiri, and Karatagi has high productivity.

Table- 8 Koppal District Composite Crop Yield Indices

Sl. No.	2010-2011				2020-2021			
	Category	**Index Range**	**No. of Talukas**	**Name of the Talukas**	**Category**	**Index Range**	**No. of Talukas**	**Name of the Talukas**
1	Low	Below 75	1	Kustagi	Low	Below 98	3	Koppal,Kustagi, Yelburga
2	Medium	75.01-87	2	Koppal, Yelburga	Medium	98.01-100	2	Gangavati, Kukanuru
3	High	Above 87.01	1	Gangavati	High	Above 100	2	Karatagi, Kanakagiri

Source: Compiled by the researcher

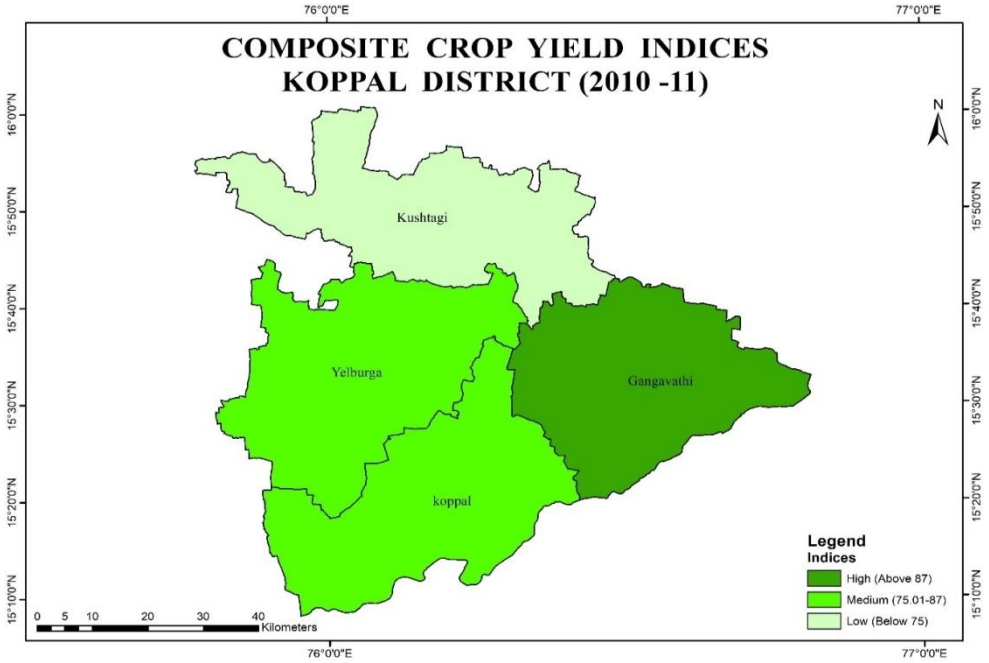
Table -9 Koppal District Arable Land Use Efficiency Regions- A New Method by V. Vidyanath

Sl. No	2010-2011				2020-2021			
	Category	**Efficiency Index**	**No. of Taluka**	**Name of the Talukas**	**Category**	**Efficiency Index**	**No. Of Taluka**	**Name of the Talukas**
1	Low	Below 50	1	Yelburga	Low	Below 90	3	Koppal, Kustagi,Yelburga
2	Medium	50.01-65	2	Koppal, Kustagi	Medium	90.01-110	2	Kukanuru, Kanakagiri
3	High	Above 65.01	1	Gangavathi	High	Above 110	2	Gangavati, Karatagi

Source: Compiled by the Researcher

Fig 10

Koppal District Composite Crop Yield Indices 2010-11 and 2020-21



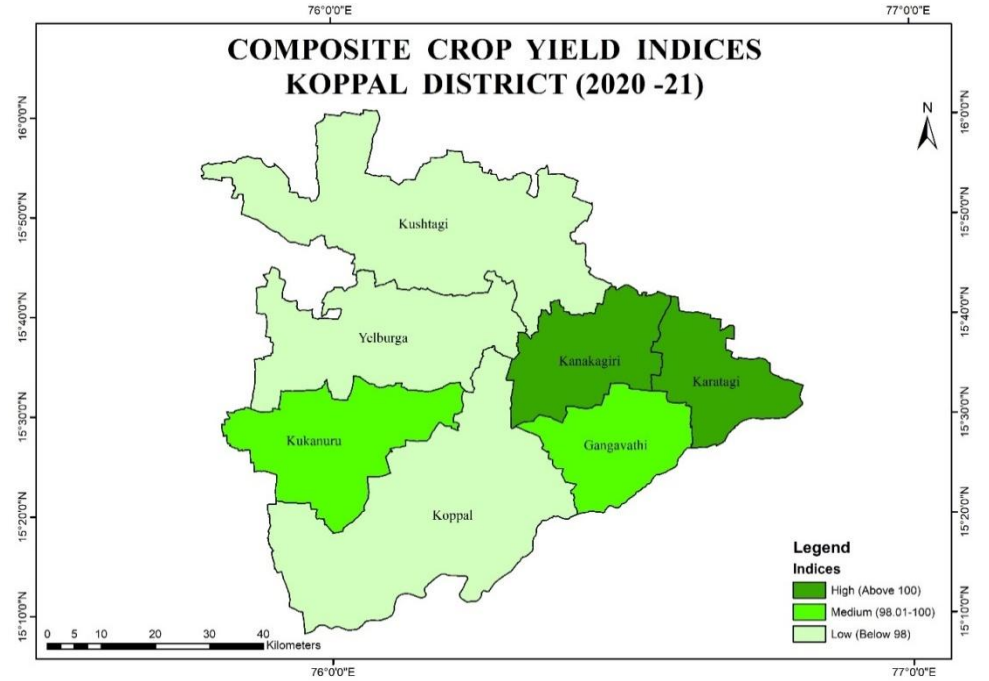
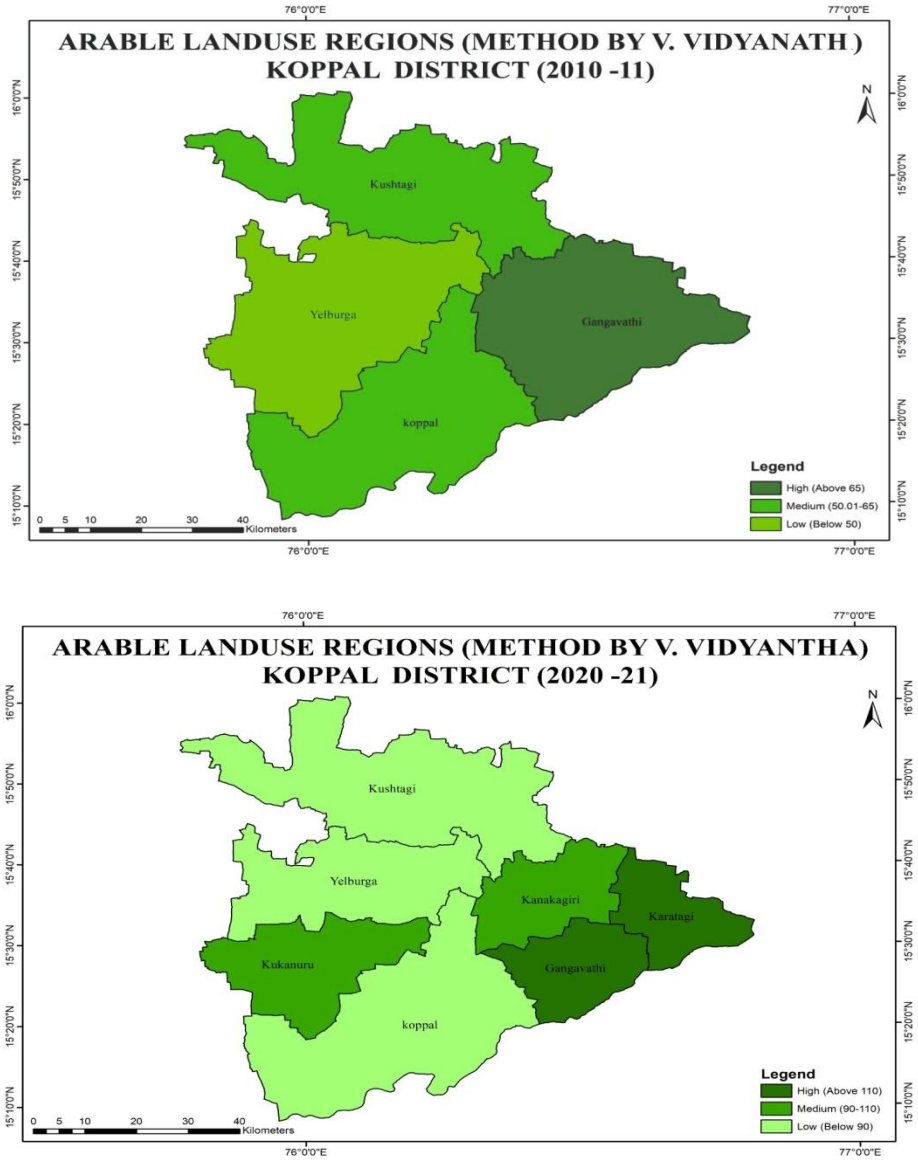


Fig 11

Koppal district Airable Land use Efficiency by V. Vidyanath's Method



As per as V Vidyanatha Airable land use efficiency in 2010-11 Yelburga has low efficiency, Koppal, and Kustagi has medium efficiency, and Gangavathi has high efficiency. During 2020-21 Koppal, Kustagi, and Yelburga has low efficiency, Kukanuru, and Kanakagiri has medium efficiency, Gangavathi, and Karatagi has high efficieancy.

According to Kendall's rank Order Score Method in 2010-11 Gangavathi comes under very high developed region. Koppal comes under high developed region. Kustagi, and Yelburga comes under medium developed regions. During 2020-21 Koppal, and Kustagi comes under very high developed region. Gangavathi comes under high developed region. Yelburga

comes under medium developed region. Karatagi, and Kukanuru comes under low developed regions. And Kanakagiri comes under very low developed regions.

Chapter-VIII: FINDINGS, STRATEGIES AND CONCLUSION

A comprehensive conclusion and summary of the entire investigation carried out in the present study and the future scope is presented in this chapter. The conclusion chapter provides the sum of all chapters together and present the findings of the output and recommendations for Spatio-temporal analysis.

Findings

Koppal district, with 552495 hectares, is located in the northern region of Karnataka state. Physiographically, the district is located in Maidan. The Koppal district receives an average yearly rainfall of 572 millimeters. Every taluka experiences at least two droughts every five years. The district has a population of 11615277 (2021 projected data), with a density of 271 people per square kilometer. The district is deprived of forest land. The primary soil types in Koppal district are red sandy, loamy, and black. The net sown area is 412341 hectares (2020-11), representing 73.84 percent of the total geographical area. Land under irrigation accounts for 30.64 percent (178872 hectares) of the net sown area (2020-1). In 2020-21, canal irrigation accounts for 22.58 percent of irrigated land, with no tank or well irrigation, 77.33 percent from tube wells, and 0.094 percent from other sources. Jowar and small millets are major rainfed crops in the district. Rice, cotton, groundnuts, and sugarcane are all irrigated crops. Bajra, Tur, and other pulses are commonly rainfed and drought-tolerant crops.

Given the district's physical characteristics, it is apparent that the area is suffering drought conditions, making agricultural development extremely difficult unless water resources (surface and subsurface) are used widely and intensely. Most of the district's soils are suitable for heavy irrigation. The black soil strip can be irrigated sparingly to keep it alkaline and salinity-free. The district has about 4.03 percent uncultivable land and 1.98 percent fallow land (2020-21). Ant crops.

The Koppal district's irrigation intensity is trending positively. However, irrigation varies from one taluka to the next when compared to 2010-11 and 2020-21, owing mostly to irrigation technology and rainfall distribution. The district's existing tanks must be dredged to boost their water storage capacity during the rainy season. During droughts, such operations might take place

in huge numbers because government funds are made available for specialized programs. Between 2010-11 and 2020-21, net sown area increased by 42484 hectares, demonstrating that irrigation improvements over the last ten years have largely contributed to this expansion.

According to 2020-21 data, groundnut is the most important commercial crop, accounting for 5.37% of net cultivated area. The most important cereal crop is Bajra, which accounts for 21.92 percent of net sown area; nonetheless, it is the dominant cereal crop, accounting for 15.81 percent. The district's land area sown more than once has grown by 6229 hectares, from 130585 hectares in 2010-11 to 136814 hectares in 2010-11. As a result, this upward trend is associated with increased irrigation area and food consumption, among other variables. The presence of monoculture and a large number of crop combinations (as measured by the J.C. Weaver Method) indicates that the Koppal district has remained a subsistence agricultural region.

As a result, the study suggests that new soil and water management technology is required to strengthen the cropping pattern, allowing agriculture to proceed to commercial grain farming and commercial non-food crop patterns.

Agricultural development indicators reveal information on agricultural productivity, efficiency, and levels of development. According to Yang's (1965) agricultural production data, Koppal, Yelburga, and Kustagi talukas have high productivity (2020-21) despite physical constraints. The Gangavati and Kukanurut alukas have medium productivity, whereas the Karatagi and Kanakagiri talukas have low productivity due to physical constraints. This situation may arise when inventions are disseminated in Koppal taluka, the district seat.

Based on a number of factors, agricultural efficiency in two talukas is anticipated to be extraordinarily high in 2020-21. This shows that the overall tendency of agricultural development in two talukas is gradual, rather than fast transformation. However, according to V. Vidyanath's Method, the results of arable land use efficiency for the year 2010-11 are encouraging, with Gangavati and Karatagi being very highly efficient talukas, Kukanuru and Karatagi appearing to be medium efficient talukas, and Yelburga, Koppal, and Kustagi low efficient talukas. The differences in arable land use efficiency levels represented on the map show that physical factors such as terrain, soil, rainfall, and irrigation infrastructure have a significant impact on both net sown area and crop output.

Agriculture development is usually associated with regional growth, assuming the region has strong social, economic, and demographic indicators. As a result, Koppal and Kustagi talukas

appear to be extremely developed (2020-21), whereas Gangavathi taluka is highly developed. Yelburga Taluka has medium development, Karatagi and Kukunaru have low development, and Kanakagiri has extremely poor development in 2020-21.

Regional disparities in agricultural development, efficiency, and productivity are positively associated. This illustrates that regional disparities influence the agricultural growth of Koppal District. In this regard, attention must be paid to talukas that are lagging behind in overall development. For example, when planning for agricultural and socioeconomic expansion, Yelburga taluka must be given high emphasis. After a careful review of features of productivity, efficiency, and regional disparities in the degrees of agricultural development, this research study broadly classifies the district into three parts for agricultural development (along with other characteristics), namely,

1. Prosperous Region : Koppal, Kustagi, and Gangavathi
2. Moderate Region : Yelburga
3. Backward Region : Kanakagiri karatagi and Kukanur

According to the examined research data, Koppal, Kushtagi, and Gangavathi talukas are prosperous, Yelburga is average, and Kanakagiri, Karatagi, and Kukanuru talukas are backward.

Thus, this thesis chapter on water resources, land use and cropping patterns, agricultural growth characteristics, infrastructure, and regional disparities offers some insights into future agricultural development.

Some of the urgent needs to be addressed in Koppal district on a priority basis include land management, water management, artificial rain making, ecology development, the use of indigenous biotechnology, the extension of medical aids for men and animals, the spread and growth of literacy, the extension of financial assistance to the poor and farmers with smaller landholdings, and the well-development of market and transportation facilities. In this regard, the current research study offers some guidance in the relevant chapter.

STARTEGIES

Since the NCA (National Commission on Agriculture) issued its recommendations fifteen years ago, attention in India has been primarily focused on targets rather than the commission's goals. Agriculture experts have expressed satisfaction with attaining the required standards for various crops. Wheat production targets grew from 86.87 million tons in 2010-11 to 100 million tonnes in 2020-21. Though the situation is favourable for rice, the goal of 104.89 million tons was

almost fulfilled in 2020-21. Realizing the aim alone does not solve important issues. On the contrary, there may be fresh issues. The fact that wheat output has already exceeded the NCA's target shows that higher production levels are possible. Unfortunately, the NCA's goals for three critical crops - coarse cereals, pulses, and oilseeds - may not be met. The production of coarse cereals has ranged between 30.33 million tons and 42.22 million tons over the last twelve years, with increases and declines depending on the monsoons. Similarly, pulses have produced around 18.24 million tons during the last twelve years.

Thus, in India, per capita pulse availability is at least 50% of what it was at the time of independence, and imports may be necessary to meet basic nutritional requirements. The NCA anticipated 30.4 million tons of coarse grains and 13.8 million tons of pulses for 1996-97, which will need to be expanded to 38.1 million tons and 23.05 million tons, respectively, by 2020 AD. The NCA's target of 254.35 million tons of food grains has been met, but the country will have an unsold surplus of wheat and rice, as well as a major lack of other commodities. Policymakers have placed a high priority on rain-fed areas, as well as pulse and oil-seed cultivation. The eleventh five-year plan predicted only a slight increase of 5 to 29 million tonnes as a result of these two crop groups, which are largely grown in rain-fed areas in India. The situation for oil seeds is also precarious, so a technology mission has been initiated to improve production by introducing new technologies.

In India, agricultural improvement over the last 40 years can be classified into three major areas: First, great progress has been achieved in constructing the scientific and educational infrastructure needed to develop and test technology appropriate for the diverse agro-ecological zones. There are multiple agriculture universities, at least one in each state, as well as various central institutions, national bureaus, and India-wide coordinated research efforts focused on crop husbandry, animal husbandry, fisheries, and forestry.

Second, a sufficiently efficient input production and distribution system has been established. Thus, there are reasonably effective mechanisms in place for knowledge and skill transfer, credit supply, and seed production and distribution.

Third, measures to support higher production by small farmers and increased consumption by the rural and urban poor have evolved throughout time.

Finally, the following enlisted programmes will be working in Koppal District.

The widespread use of underground water, as well as greater lift irrigation along Tungabhadra's riverside, should be undertaken. Water should be used as sprinkler or drip irrigation to reduce water waste and its repercussions, such as soil structure damage.

The development of dry land farming in the district should adhere to ICRISAT guidelines. This ensures that rainwater is not wasted, hence preventing soil erosion. This strategy should be limited to dry land crops such as Jowar, Bajra, Minor millets, Groundnut, and so on, rather than wet crops like sugarcane and rice. The water held in the "Farm Ponds" should only be used when the rains stop. Except for irrigated and heavy rainfall talukas, the rest of Koppal district's talukas are excellent.

Controlling soil erosion

Though bunding and terrace cultivation should be encouraged in appropriate districts, agriculture organizations should take the lead in financing and propagating these concepts.

Artificial Rain making

During the South West monsoon season, moisture-laden clouds moving eastward at 40 to 60 km/h rarely bring rain to the district's rain shadow zone. This state results from the absence of vegetation-covered hill ranges. As a result, this type of situation creates uncertainty in the distribution and frequency of rainfall. As a result, in order to obtain rainfall from such moisture-laden thick clouds, artificial rainmaking is required. Though this incurs significant financial costs, it is unavoidable in order to meet the crop's moisture requirements.

The Maintenance of Ecology

The ecological imbalance in the district can be addressed by adopting social forestry on all wastelands. Quick-growing plant species must be used on farm boundaries, roadsides, hillslopes, and existing forest lands in Koppal district. If implemented on a broad scale, this program will surely boost ecological growth, resulting in a decrease in soil erosion, micro-level development, and other ecological and environmental difficulties.

Widespread and intensive use of modern technology

The majority of farmers in the Koppal area continue to employ outdated agricultural equipment that does not produce efficient and effective results in terms of increasing agricultural yields from the soil.

Second, even if the farmers in the district are illiterate, they can be taught how to use modern equipment and other agricultural inputs, and a scientist should be recruited to oversee the farm and the farmers in an area with a radius of 10,000 people or more.

Furthermore, boosting agricultural output in the district can be accomplished by performing extensive indigenous bio-technological research in various regions of the district that are tailored to the unique ecology of the areas. The Indian Agriculture University and other scientific institutes, including as ICRISTA and ICAR, have already devised closed polling procedures that may be used by even the poorest farmers with small landholdings.

Literacy needs to be increased.

Another target must be achieved in Koppal district. The overall literacy rate in Koppal district is 68.09 percent. This rate is lower than the state average of 75.60 percent. However, it is not a factor in determining contentment. As a result, boosting farmers' awareness through literacy is critical. If literacy is widespread in the district, farmers will produce more effectively, resulting in higher yields. In this context, existing adult education initiatives should be successful in educating illiterate rural farmers. They should be made aware of the benefits of modern technologies

Commercialization of Agriculture

If properly harnessed, the water of the Tungabhadra River has the potential to enhance the economic position of the inhabitants of Koppal district. Empirical evidence reveals that certain positive tendencies exist along the urban-rural continuum, at least in commercialized irrigation farming districts and on higher order urban margins. As a result, the Koppal district has to expand its marketing and transportation infrastructure, with rural service centers acting as nodes and focal points for developing and distributing agricultural innovations throughout the region.

An inventory of village-level data is required for periodic agricultural situation assessments (at least every five years). This strategy should be applied as soon as possible. So that accurate and appropriate metrics may be employed at the right moment to solve issues with farm management, agricultural productivity, and so on.

As a result, we must keep a computerized database of various aspects of agriculture in each town and land holding. Geographers and other scientists studying agricultural expansion and regional planning may find this information incredibly useful.

Thus, the substantial research undertaken in this thesis indicates that the Koppal district will emerge as a commercial farming area, notably in the canal and lift irrigation zones. Farmers in rainfed locations will prioritize high-producing cultivars based on microbiological results.

This type of study is expected to provide adequate information on agricultural difficulties and prospects, as well as rural development at the micro level. As a result, the current research activities are projected to provide a substantial contribution to our understanding of the regional characteristics of agriculture in India in general, and the Koppal district in particular.

Conclusion

The rural population is diminishing due to migration from rural to urban areas. Yelburga taluka has the district's largest rural population (94.46%), followed by Kushtagi (91.26%), Koppal (78.99%), and Gangavati (75.07%). Gangavati taluka in Koppal district has the highest population density, land-population ratio, and sex ratio among the study areas. According to projected data for 2021, the Koppal district ranks 25th in terms of literacy rate. Koppal taluka (70.58%) has the highest literacy rate in the study area. Kukanuru taluka (74.15%) has the most persons involved in primary activity, while Kustagi taluka in Koppal district has the most agricultural labourers (45.84%).

Irrigation will have an impact not just on agricultural productivity but also on the economic structure of society. In this regard, the research region is not unique. Farmers are transitioning from traditional crop patterns to commercial farming by irrigating their crops. Economic growth will be made in the village or tahasil if all or a portion of the agricultural area in the study region is irrigated gradually.

Soil conservation and maintenance are also critical for ensuring consistent and long-term agricultural growth. Because of the limited rainfall, it is vital to exploit subsurface and surface water resources for agricultural development. We must also test the water to ensure that it is saline-free; only then can we use it for agricultural development. Because of the increasing growth of population and animals, we need to raise yields per unit area without adding new agricultural land.To meet the food needs of a growing population, we must employ innovative agricultural development methods and technologies. Whatever water is available for irrigation must be used effectively to avoid wasting water resources.

During both study years, over fourteen crops were grown in the study area. Crop ranking patterns differ by taluka, demonstrating the importance of crop value and utility. The crop

concentration study allows us to identify which talukas are susceptible to soil ecology degradation and how to counteract it by altering the concentration range. Crop concentration corresponds to irrigation intensity, and vice versa. The crop combination study reveals that there are no eights or higher over the whole research region. According to the J.C. Weaver approach, the district features monoculture with fifteen crop combinations. It is worth mentioning that talukas with fewer crops (one or two) are either under-irrigated or have a lower share of commercial crops. In the case of a larger crop combination (15 crops), the more talukas are irrigated or have a higher proportion of commercial crops. Cropping intensity is a measure of how frequently arable land is utilized. A higher percentage of irrigated land leads to increased intensity, whereas low intensity is visible in dry farming talukas. Similarly, crop diversification is linked to soil quality, rainfall, and irrigation percentages. Thus, the entire chapter presents us with recommendations for working on agricultural regionalization in Karnataka's Koppal region.

Agricultural growth in Koppal district is influenced by regional variances. As a result, it is critical to reduce the disparity in development among talukas. This could lead to a reduction in gaps in agricultural development levels.

This type of study is expected to provide adequate information on agricultural difficulties and prospects, as well as rural development at the micro level. As a result, it is anticipated that the current research efforts will make a substantial contribution to our understanding of the regional characteristics of agriculture in India in general, and the Koppal district specifically.

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LIST OF PUBLICATIONS OF THE AUTHOR

In Journals/ Proceedings:

- Title of the paper: “watershed Development and its impact on LULC changes in Bedwatti of Koppal District, Karnataka: A Geospatial technique” Volume 7 Issue 12 12 December. ISSN: 2582-3390
- Title of the paper: Changing Scenario of Crop Intensity in Koppal District: A Geographical Study, Volume 12 Issue 12 12 December. ISSN: 2320-2882

PRESENTATION DETAILS:

- Presented paper entitled “watershed Development and its impact on LULC changes in Bedwatti of Koppal District, Karnataka: A Geospatial technique” at 18th Deccan Geographical society of India by Department of Geography, Osmania University, Hyderabad on 5-7 March 2024.
- Presented paper entitled Changing Scenario of Crop Intensity In Koppal District: A Geographical Study at 46th IGC (NAGI) by Department of Geography, Osmania University, Hyderabad on 27-29 December 2024.

ATTENDED:

- Participated in the three-day National Level VVFGC_CIIL Collaborative Development program on “Research Methodological Issues vs Linguistic Aspects of Research” During July 12-14, 2018.
- Attended International Geography Conference on “Sustainable Rural Development-Geospatial Solutions” Department of Geography and Geoinformatics, Bangalore University, Bengaluru. On September 20-22, 2018.
- Participated in the Capacity Building Workshop on “The Future of Higher Education: Opportunities and Challenges” at Mangalore University, Mangalgangothri on 18-05-2019.

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